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ABSTRACT

The paper discusses a study in which a cognitive mapping test was used to evaluate the effectiveness of different teaching methods used in a college level introductory economics course. Cognitive style mapping is a method of studying learner characteristics in order to individualize instruction. The hypothesis was that certain cognitive learning styles would determine whether students would benefit from a simulation/gaming or a lecture/discussion section. Data regarding cognitive learning style were obtained by administering a cognitive style questionnaire. Questions focused on whether students gained meaning from spoken or written words, could place themselves in other people's position, were strongly influenced by peers, and made their own decision. Student grades served as the measure of economic knowledge obtained in the course. Statistical analysis of questionnaire responses and course grades indicated that most students preferred one teaching method over the other and achieved higher grades on tests when the course was taught by the method they preferred. The conclusion is that teachers should use cognitive mapping tests to help determine the type of instruction which will benefit various types of students. (DB)

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THE USE OF A COGNITIVE MAPPING TEST TO ANALYZE THE EFFECTIVENESS OF A COLLEGE ECONOMICS SURVEY COURSE

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Introduction

The use of simulation games in college economics courses and teacher in-service courses has become popular during the last 15 years. The results of the research conducted on the use of simulation games to teach college economics, however, have at best been conflicting. Various articles report positive findings while other numerous reports cite inconclusive findings. These conflicting findings may be due to the lack of emphasis placed on identifying the type of student who would benefit from a simulation-gaming method of instruction [2,9]. Many variables have been used; however, one variable that has received little or no attention is a measure of the individual student's learning style.

Cognitive style mapping (developed by Joseph Hill and his associates at Oakland Community College, Bloomfield, Michigan) is a method of studying learner characteristics in order to individualize instruction. Cognitive style provides a vehicle within which the relationship of the important student learner characteristics, the mode of presentation, and the instructional setting can be considered [13]. Cognitive style refers to the different ways in which students assimilate knowledge.

The authors wish to thank Associate Professor David Straits of the Education Department at Ashland College for assistance with the Cognitive Style Questionnaire.

The thesis of the study examined in this paper was that college-level introductory economics students with certain cognitive learning styles would benefit from a simulation-gaming method of instruction, while students with other learning styles would benefit from a lecture-discussion method. The emphasis of the evaluation was placed on determining if the type of student who would benefit from different methods of instruction could be identified based on personal characteristics and learning style.

Experimental Design

In order to test this thesis, several hypotheses were developed. Simulation-gaming teaching was hypothesized to be superior to the lecture-discussion method of teaching for students with certain learning styles (and vice versa). In addition, it was hypothesized that the cognitive style questionnaire could be used to establish a cutoff point for placing students in the course section taught by the appropriate method. It was further hypothesized that other personal characteristics would change the cutoff point established by the cognitive style questionnaire.

The design of this study involved the use of two methods of instruction and two instructors with each instructor teaching one class by each method. The lecture-discussion method of instruction was designated the control while the simulation-gaming method was designated the experimental method.

The Lecture-Discussion Method. The basic feature of the lecture-discussion method of instruction was the instructor's lectures. However, since student questions and comments were encouraged, discussions of the

economic concepts by the instructor and students were a part of the instructional process. This lecture-discussion method of instruction was designated as the control method because it was the most frequently utilized method of instruction in the Economics Department at Ashland College.

The Simulation-Gaming Method. The students exposed to the simulation-gaming method of instruction were provided copies of the same course syllabus and used the same textbook as did the students who were enrolled in the control classes. However, the simulation-gaming method of instruction involved the integration of simulation activities with the lecture-discussion method of instruction. A total of 18-1/3 class periods were either devoted to playing the simulation activities or spent on the debriefing sessions. Thus, approximately 50% of the 37 class periods used for instruction were devoted to the simulation activities. The seven simulation activities that were used in the simulation gaming technique and the order in which these activities were presented were as follows: (a) Outdoor Endurance [12], (b) Starting a Small Business: A Simulation Game [4], (c) The Multiplier [14], (d) Mr. Banker [10], (e) Tightrope [5], (f) Specialization [3], and Baldicer [15].[1]

Study Implementation

The Ashland College freshman students of the 1978-1979 academic year who declared an intent to major or minor in business administration or economics were defined as the population for this study. A total of 175 freshman students had indicated on pre-registration forms

their intent to major or minor in business administration or economics. Since four course sections were made available for this study and each section normally contained 30 students, 120 of the 175 students were randomly sampled. Each of the 120 students was randomly assigned to one of the four course sections used in the study.

The students in two of the course sections were taught using the simulation-gaming method of instruction. The students in the other two sections were taught using the lecture-discussion method of instruction. Two instructors were used to teach the four course sections. Each instructor was randomly assigned to a simulation-gaming section and a lecture-discussion section of the introductory economics course. The introductory course was a one-semester economics course that included both microeconomic and macroeconomic concepts.

Data

Student grades served as the measure of economic knowledge they obtained in the economics course. The students' grades, which served as the dependent variable in the regression analysis, were measured on an 11-point scale with F=0 and A=11.

In order to determine what type of student would be benefitted in his learning by simulation games, measures of various student attributes were obtained.

The most important attribute, given the thesis of the study, was cognitive learning style. The cognitive learning style data were obtained by administering the Cognitive Style Questionnaire developed by Strother [13]. The complete inventory includes 27 subscores.

However, since this experiment was an investigation of the use of simulation activities, only those subscores dealing with learning style characteristics important in the use of this teaching technique were utilized [1]. The seven subscores selected were as follows:

1. Theoretical Auditory Linguistic [T(AL)]: the student obtains meaning from spoken words.
2. Theoretical Auditory Quantitative [T(AQ)]: the student obtains meaning from spoken numerals or mathematical symbols.
3. Theoretical Visual Linguistics [T(VL)]: the student obtains meaning from written words.
4. Theoretical Visual Quantitative [T(VQ)]: the student obtains meaning from written numerals or mathematical symbols.
5. Qualitative Code Empathetic [Q(CEM)]: the student has the ability to place himself in another person's position.
6. Associates (A): the student is influenced by his peers or associates.
7. Individuality (I): the student directs his own behavior and makes his own decisions.

The seven subscores were selected on the basis that certain student traits would prove beneficial for students to possess when taught by the simulation-gaming method while other traits would be essential for students to possess when taught by the lecture-discussion method. Since the simulation activities used in the experimental

classes involved verbal interaction among the participants or the performance of responses to verbal messages, the traits measured by the subscores T(AL) and T(AQ) were identified as important traits for students to possess when taught by the simulation-gaming method. In addition, the simulation activities required the students to role play, empathize with that role, and interact with their peer-group. Thus, subscores Q(CEM) and A were recorded.

Three traits measured by the Cognitive Style Questionnaire appeared important for the students taught by the lecture-discussion method to possess. More emphasis was placed in the lecture-discussion classes on the use of the textbook and the instructor's notes that were written on the blackboard. Therefore, the subscores T(VL) and T(VQ) were included in the project. The third trait that appeared important for a student to possess when taught by the lecture-discussion method was the student's ability to be self-directed. Therefore, subscore I was recorded for each student.

It was essential for the evaluation of this study that the seven subscores be added together to obtain one score. The resulting sum was used to predict which students would most benefit from each method of instruction. However, the subscores corresponding to the lecture-discussion method--T(VL), T(VQ), and I--had to be transformed before the seven subscores could be added together to obtain a meaningful total score. Since the maximum score for any one section of the Cognitive Style Questionnaire was 40, each of the subscores corresponding to the lecture-discussion method was subtracted from 40. After the transformation of subscores had been completed and the subscales had

been added together, the resulting total score could be interpreted. A student with a high total score should have performed better if taught by the simulation-gaming method. A student with a low total score should have performed better when taught by the lecture-discussion method.

Other independent variables were utilized in this study in addition to the cognitive learning styles variable. Two of these independent variables were the method of instruction and the instructor to whom each student was exposed. The other independent variables were the student's scholastic abilities, high school economic training, and previous interest in economics.

A student's Scholastic Aptitude Test score (SAT) or American College Test score (ACT), which was converted to a SAT score, was used as the measure of a student's scholastic ability. A student who had at least nine weeks of high school economic instruction was identified as having had previous training in economics.

With respect to a student's interest in economics, the question whether pre-course or post-course interest should have been used was a valid question. However, since the ultimate purpose of the study was to provide insight into the separation of students into the classes taught by the most appropriate of the two teaching techniques at the beginning of the course, pre-course interest was chosen. The Questionnaire of Student Attitudes Towards Economics (QSATE) was used to measure the students' pre-course interests towards economics (see Karstensson and Vedder [6] for test reliability and validity).

All the variables utilized in the study are listed in Table 1. In addition, the mean, standard deviation, and t-test values for the variables are presented in Table 2.

Insert Table 1 and Table 2 about here

There were no statistically significant differences between the means of the experimental and control groups for the independent variables at the .05 alpha level.

Data Analysis

The thesis of this study was that matching a student's learning style and the method of instruction would result in superior achievement in understanding economics. Stated in another way, the hypothesis was that the simulation-gaming method of instruction would be superior to the lecture-discussion method of instruction for only certain types of students.

Using the previously discussed cognitive style scores and grades, the following hypothesis was tested:

$1H_0$: An interaction effect did not exist between the methods of instruction and the students' cognitive learning style score when accounting for the variations in the students' performance in an economics survey class over and above the influence of the methods of instruction and cognitive learning style scores.

Multiple linear regression models were constructed to test Hypothesis $1H_0$. A regression model, which was identified as the restricted regression model, was designed to depict the conditions stated in the research hypothesis, $1H_0$. In a similar fashion, a regression

model, which was identified as the full regression model, was designed to reflect the situation depicted in the corresponding research hypothesis. The results of the F test conducted on the R^2 values of the restricted and full regression models were used to test Hypothesis $1H_0$.[2]

The values resulting from the analysis of the data examined by Hypothesis $1H_0$ are presented in Table 3.

Insert Table 3 about here

The interaction effect examined in Hypothesis $1H_0$ accounted for 6.5% of the variation in the students' performance. The 6.5% of explained variation in the students' performance in the economics survey course produced an F value of 7.13, which was significant at the .01 alpha level. Therefore, the interaction between the methods of instruction and the cognitive learning style scores did account for a statistically significant amount of the students' performance in the economics survey course.

A graph of this statistically significant interaction is presented in Figure 1. The graph presented in Figure 1 was obtained by plotting the regression weights of the independent variables of the full regression model used to test Hypothesis $1H_0$. The y-intercept values for the control and experimental groups corresponded to the values for a_0 (12.23) and a_0 plus a_2 (-7.21), respectively. The slopes of the lines for the control and experimental groups corresponded to the values for a_4 (-.045) and a_5 (.084), respectively.

Insert Figure 1 about here

An examination of the graph of the interaction effect presented in Figure 1 indicated that the interaction effect was disordinal. The simultaneous solution of the two regression lines revealed an important result. The students assigned to the experimental classes who had cognitive learning style scores above 151, which was slightly above the average score of 148, generally received higher final grades in the economics survey course than did their counterparts who were assigned to the control classes. However, the students assigned to the control classes who had cognitive learning style scores below 151 points tended to record higher grades in the economics survey course than did their counterparts who were assigned to the experimental classes.

It is obvious, of course, that many factors will affect a student's performance in learning any subject. In an attempt, in a sense, to evaluate the "stability" of the interaction effect uncovered by the previous analysis, several additional hypotheses were tested.

One hypothesis was the same test as above but with other personal characteristics covaried. This resulted in higher R^2 values for both full and restricted models. The interaction effect was significant at the .01 alpha level, however, it explained only 4.3% additional variation, somewhat less than the first analysis. Probably the most important result was that the disordinal interaction insected at a

cognitive learning score of 153, nearly the same value as the first analysis.

An additional hypothesis was tested to further investigate the "stability" of this result. Basically, this test was a two-way interaction test between learning style and method of instruction and SAT score and method of instruction. Specifically the hypothesis was:

$2H_0$: An interaction effect did not exist between the methods of instruction and the students' cognitive learning style score and between the methods of instruction and the students' scholastic abilities (SAT score) when accounting for the variations in the students' performance in an economics survey class over and above the influence of the methods of instruction, cognitive learning style score, and SAT score.

Again, multiple linear regression models were constructed to test this hypothesis. The results of this analysis are presented in Table 4.

The interaction effects examined in hypothesis $2H_0$ accounted for 4.7% of the variation in the students' performance. This produced an F value of 4.5 which was significant at the .05 alpha level. Further analysis revealed that only .9% of the variation was due to the SAT interaction, thus 3.7% was due to the cognitive learning style interaction.

Insert Table 4 about here

A graph of the interaction effects is presented in Figure 2. Notice that this is a three-dimensional figure. Since two interaction effects are being considered together, the result is an investigation

of the interaction of linear surfaces. The equation for these surfaces are:

Control: 5.713 + 2.167 SAT - .038 Cognitive score

Experimental: 5.057 + 1.770 SAT + 1.181 Cognitive score

Examination of the graph of interaction effects presented in Figure 2 indicates that the effects are disordinal. The simultaneous solution of the two planes results in a line which represents the change in the cognitive score intersection value as SAT of the student changes.

Insert Figure 2 about here

There are two important results from this equation. First, at the mean of SAT (829) the intersection of the planes in terms of cognitive score would be 153.6, very close to the 151 determined with no consideration of other variables and to the 153 when other personal characteristics are included.

Secondly, and most importantly, an increase in the SAT score had some but not a great effect on the cognitive score intersection. This can be seen in Figure 2 by comparing the line of intersection of the planes, labeled A, with the plane labeled B. The top line of Plane B shows a constant cognitive score of 152.6 (the intersection point at SAT of 750) as the control plane is affected by SAT. The value of the intersection point of the planes at SAT of 950 is 157.5. Thus, a 200-point change in SAT results in about a 5-point change in

cognitive score at which the planes intersect. A one standard deviation change in SAT (168 points) would change the intersection value by about 4 points. The relationship appears to be relatively stable.

Implications

The results of the analyses of Hypotheses $1H_0$ and $2H_0$ supported the thesis of this study. The results indicated that neither the simulation-gaming method of instruction nor the lecture-discussion method of instruction was a superior method for teaching the economics survey course. The simulation-gaming method was the superior method of instruction only for the students that possessed certain cognitive style characteristics. The Cognitive Style Questionnaire appeared to be successful in identifying those characteristics. The results also indicated that this simulation-gaming method of instruction was detrimental to students with other cognitive style characteristics.

Two important implications resulted from this study. First, this simulation-gaming method was successful in improving the performance of certain types of students in a college economics survey course. Since the Cognitive Style Questionnaire requires approximately one hour to administer, the questionnaire appears feasible to use as a means of placing students in the appropriate course sections. In addition, the direct costs of the simulation activities used were minimal. Therefore, the apparent benefits received by certain students in the form of higher final economics may well outweigh the direct cost of implementing this simulation-gaming method.

Second, in a more general nature, it appears important for teachers and researchers to determine the type of students who benefit from not only the simulation-gaming method of instruction but also other methods of instruction. It is naive to think that a given method of instruction will be superior to other methods for all students. Future research projects in economics education should be designed with this point in mind.

Notes

1. A detailed description of the methods of instruction can be found in Chapter III of the doctoral thesis by J. Fraas [2].

2. The F value for each hypothesis was calculated by the following formula:

$$F = \frac{(R_F^2 - F_R^2) \;/\; (m_1 - m_2)}{(1 - R_F^2) \;/\; (N - m_1)}$$

R_F^2 and R_R^2 represented the total variance in the criterion variable that was accounted for by the variation in the predictor variables in the full and restricted regression models, respectively. The symbols m_1 and m_2 represented the number of linearly independent vectors in the full and restricted regression models, respectively. N represented the number of students being examined by the given hypothesis.

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Table 1. Description of Variables

Variables	Description of Variables
Y_1	Final grades for the economics survey course (F = 0, D- = 1, D = 2, D+ = 3, C- = 4, C = 5, C+ = 6, B- = 7, B = 8, B+ = 9, A- = 10, A = 11)
X_1	Students exposed to the lecture-discussion method of instruction (yes = 1, no = 0)
X_2	Students exposed to the simulation-gaming method of instruction (yes = 1, no = 0)
X_3	The student cognitive learning style scores
X_4	Cognitive learning style scores of the students exposed to the lecture-discussion method of instruction ($X_1 \cdot X_3$)
X_5	Cognitive learning style scores of the students exposed to the simulation gaming method of instruction ($X_2 \cdot X_3$)
X_6	Scholastic Ability (SAT score, 400 - 1600)
X_7	Scholastic ability of those students exposed to the lecture-discussion method of instruction ($X_1 \cdot X_6$)
X_8	Scholastic ability of those students exposed to the simulation-gaming method of instruction ($X_2 \cdot X_6$)
X_9	Students with high school economics instruction (yes = 1 no = 0)
X_{10}	Teacher A (yes = 1, no = 0)
X_{11}	Pre-course interest in economics (Pre-course QSATE score, 8 - 40)

Table 2. Means, Standard Deviations, and t values for the Experimental and Control Grou

Variable	(n = 52) Control		(n = 53) Experimental		t value
	$\bar{X}$	SD	$\bar{X}$	SD	
Final grade (Y_1)	5.52	2.98	5.09	3.15	---
Cognitive learning style score (X_3)	148.92	11.67	146.42	12.77	1.05
Scholastic ability (X_6)	814.23	168.26	844.34	168.07	1.30
High school economics (X_9)	.327[a]	--	.415[a]	---	1.44
Teacher A (X_{10})	.558[a]	--	.472[a]	---	.88
Pre-course interest (X_{11})	29.40	3.47	30.60	3.09	1.87

[a] the proportion of students

Table 3. Test Results for Hypothesis $1H_0$

Full Model:	$Y_1 = a_0U + a_2X_2 + a_4X_4 + a_5X_5 + E_1$
	(12.23) (-19.44) (-.045) (.084)
Restriction:	$a_4 = a_5$
Restricted Model:	$Y_1 = a_0U + a_2X_2 + a_3X_3 + E$
	(1.65) (-.36) (.026)
Full Model $\underline{R}^2$:	.080
Restricted Model $\underline{R}^2$:	.015
df	1/101
F	7.13[a]

Note. The regression coefficients are contained in the parentheses.

[a]Significant at the .01 alpha level.

Table 4. Test Results for Hypothesis $2H_0$

Full Model:	$Y_1 = a_0U + a_2X_2 + a_4X_4 + a_5X_5 +$ (5.713) (-.656) (-.038) (1.181) $a_7X_7 + a_8X_8 + E_1$ (2.166) (1.770)
Restrictions:	$a_4 = a_5$ and $a_7 = a_8$
Restricted Model:	$Y_1 = a_0U + a_2X_2 + a_3X_3 + a_6X_6$ (5.630) (-.655) (.050) (.012)
Full Model $\underline{R}^2$:	.482
Restricted Model $\underline{R}^2$:	.435
$\underline{df}$	2/99
$\underline{F}$	4.52[a]

Note. The regression coefficients are contained in the parentheses.

[a]Significant at the .05 alpha level.

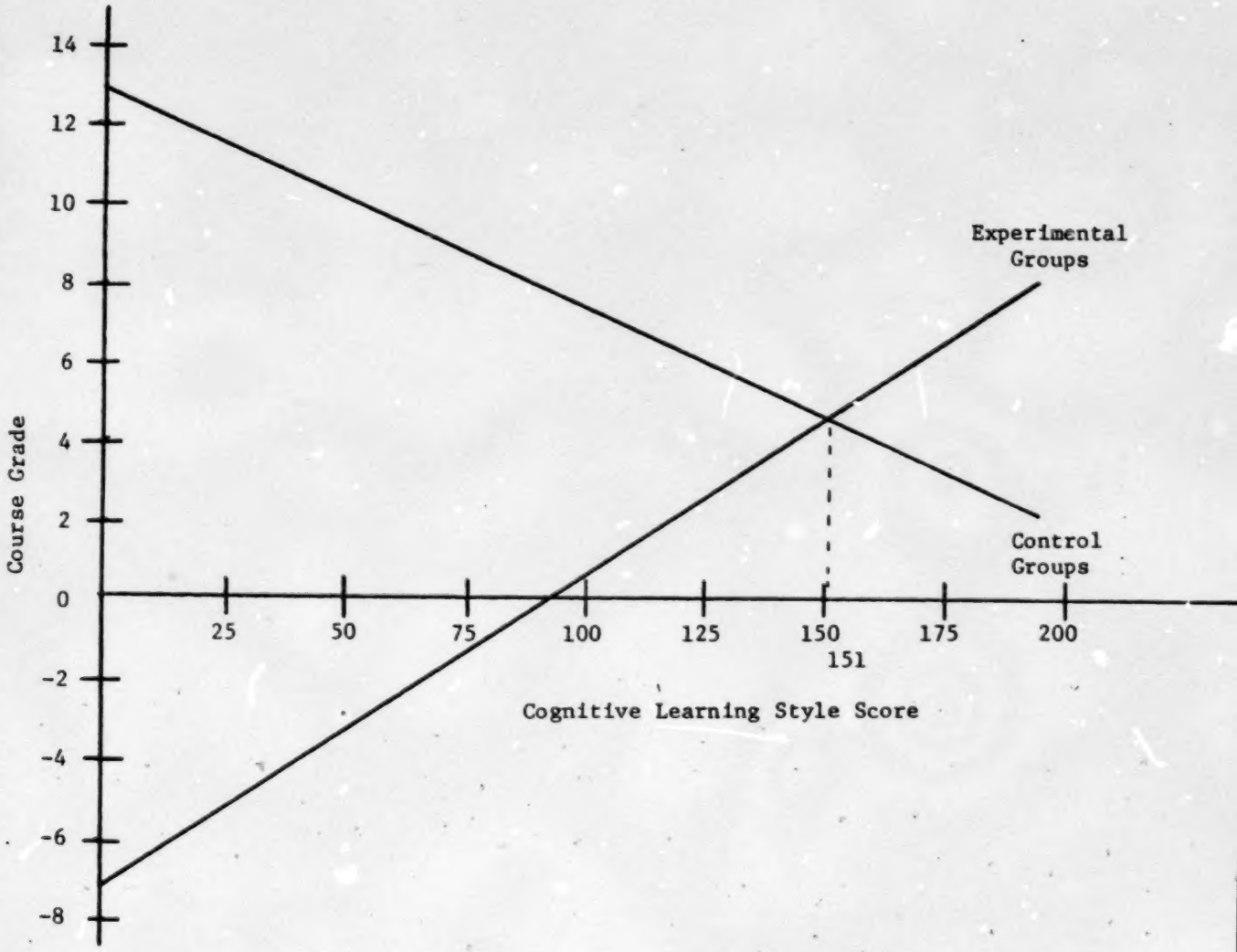

Figure 1. Interaction Between the Methods of Instruction and the Cognitive Learning Style Scores

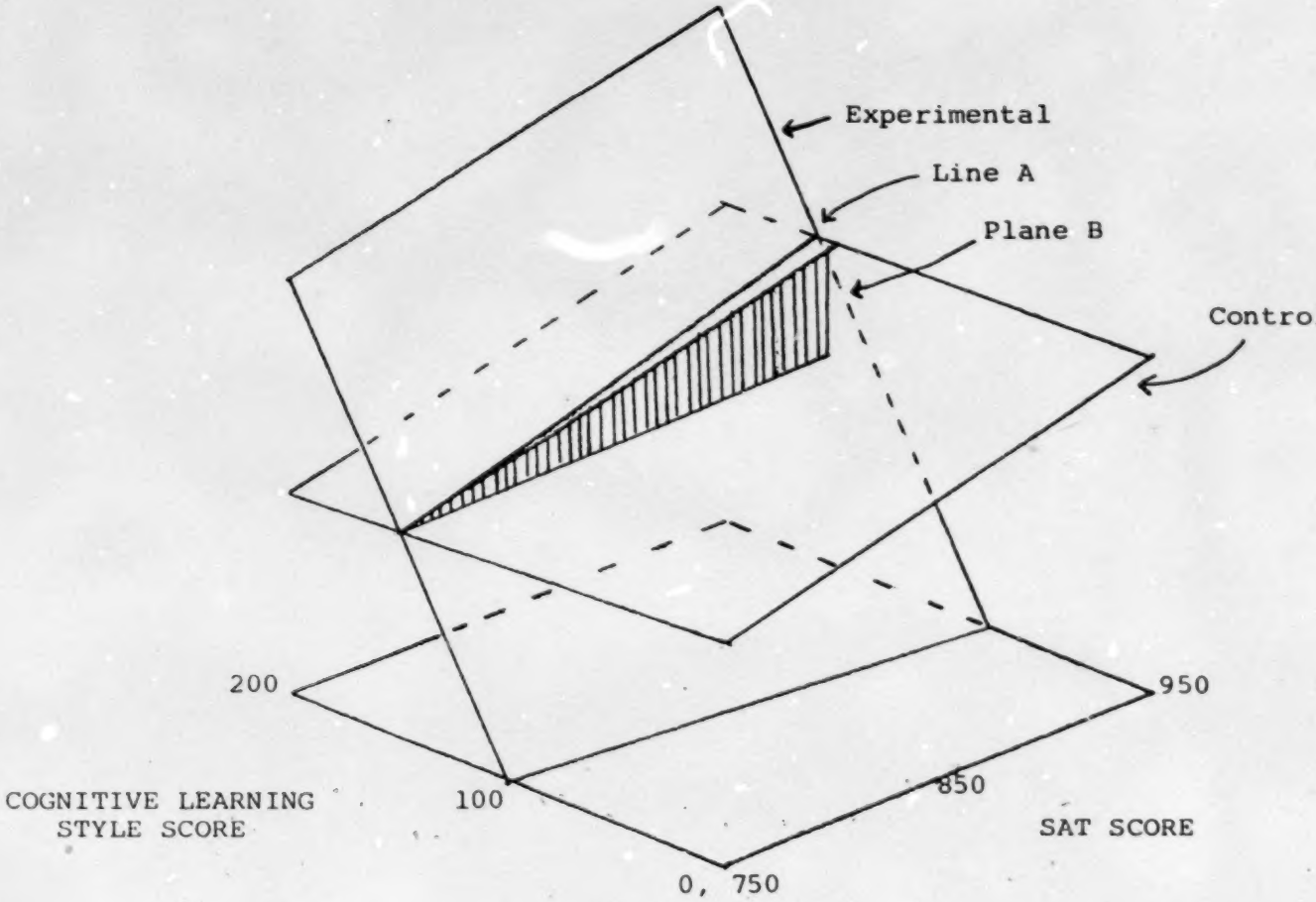

Figure 2. Interaction Between the Methods of Instruction, the Cognitive Learning Style Scores and Scholasti Ability (SAT) Scores.